Flexible Supercapacitors for Biomedical Applications

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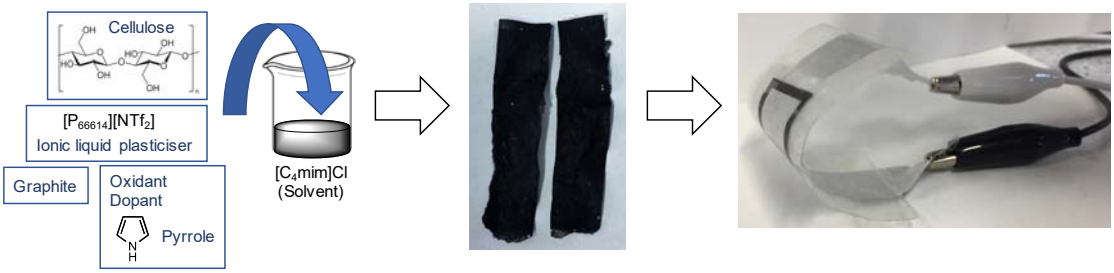
There is an urging need to develop flexible, ultrathin and safe energy storage devices to "power-up" bioelectronics and implantable biomedical devices. To address this issue, we approached the development of supercapacitors that are flexible and biocompatible using the multifunctional role of ionic liquids (ILs). The main challenge to design such supercapacitors to be flexible lies in the development of flexible electrodes and leak proof solid-state electrolytes that should retain characteristics of high power density, long cycle life and high efficiency.[1,2]

The current work presents the development of flexible electronic materials consisting of biopolymer, conducting polymer and IL composites as electrodes.[3] Fabrication of three energy storage devices *viz.* (i) electrochemical supercapacitor, (ii) electrical double-layer and (iii) hybrid supercapacitor have been carried out and their electrochemical properties were investigated using cyclic voltammetry, galvanostatic charge-discharge and electrochemical impedance spectroscopy. The chemical and morphological nature of these composite electrodes before and after the cycling process was studied using vibrational spectroscopy and electron microscopy to develop a scientific understanding on the stability of these devices for biomedical applications.[4] These new flexible supercapacitors showed specific capacitance values around 4 mF g^{-1} which will be sufficient to activate biosensors and possess long cycle life of >15000 cycles with nearly 100% efficiency. This discovery opens up a novel platform of research on next-generation energy devices.



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